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AUTHOR Goodell, Joanne E.; Agelidis, Vassilios G.
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ABSTRACT

This paper describes how one engineering faculty member redesigned his first-year course in response to feedback from students wanting to have more personable and inviting relationships with their lecturer. Now, two years after these changes were made, student feedback collected through a modified version of the Invitational Teaching Survey (ITS) demonstrates that the approaches of invitational teaching can be used successfully with Web-based courses to ease the transition from high-school to university by helping to create a more inviting and inclusive atmosphere, even in very large classes. Appendices include the ITS (1999); tabulation of mean scores on individual items of the ITS; and factor loadings for the ITS. Contains 19 references. (Author/AEF)

TRANSFORMING THE FIRST-YEAR EXPERIENCE IN ENGINEERING USING WEBCT AND INVITATIONAL TEACHING

Joanne E. Goodell, Cleveland State University

Vassilios G. Agelidis, University of Glasgow

Address for Correspondence

Dr. Joanne E. Goodell
Department of Specialized Instructional Programs
Cleveland State University
1860 E. 22nd Street
Cleveland, Ohio, 44115
phone 216 687 5426
email j.goodell@csuohio.edu

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This paper describes how one engineering faculty member redesigned his first-year course in response to feedback from students wanting to have more personable and inviting relationships with their lecturer. Now, two years after these changes were made, student feedback collected through a modified version of the Invitational Teaching Survey (ITS) demonstrates that the approaches of invitational teaching can be used successfully with web-based courses to ease the transition from high-school to university by helping to create a more inviting and inclusive atmosphere even in very large classes.

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Vassilios G. Agelidis, University of Glasgow

INTRODUCTION

Traditional engineering courses have historically been intentionally uninviting to many students, particularly women, because of "chilly" learning environments (Collins, Bayer, & Hirschfeld, 1997; Copeland, 1995). This paper describes how one engineering faculty member redesigned his first-year course in response to feedback from students wanting to have more personable and inviting relationships with their lecturer. Now, two years after these changes were made, student feedback collected through a modified version of the Invitational Teaching Survey (ITS) (Amos, Purkey, & Smith, 1987) demonstrates that the approaches of invitational teaching can be used successfully with web-based courses to ease the transition from high-school to university by helping to create a more inviting and inclusive atmosphere even in very large classes.

BACKGROUND

In 1997, a new foundation unit in Electrical Engineering was introduced for all students enrolled in first-year courses within the School of Electrical and Computer Engineering at Curtin University. The content of this unit covered fundamental physics topics, with demanding and highly abstract concepts such as electric and magnetic field theory. The unit strictly followed a number of chapters from Serway's "Physics for Scientists and Engineers" (1996) and was taught by one lecturer for 3 hours per week, with an additional 3 hours of laboratories and 1 hour of tutorial every two weeks. At the end of first semester 1997, students from this class were surveyed to gauge their responses to the new course. The results of this evaluation have been reported elsewhere (Agelidis & Calais, 1997; Calais, 1997). The most significant feedback given by the students related to the presentation of the material and the creating of a more personal and

individualized learning environment (Calais, 1997).

As a result of this feedback, a number of changes were instituted in 1998, with further enhancements made possible in 1999 through the use of WebCT. The tutorial and laboratory structure was changed to two hours of lectures, one hour of tutorial and two hours of laboratories per week. The course was also shortened slightly. However, the most significant changes occurred in the way the lecturer presented the material and tried to make the learning environment more personal and inviting.

THEORETICAL FRAMEWORK

The approaches of invitational education (Purkey & Novak, 1992), and connected teaching (Baxter Magolda, 1992; Becker, 1995; Davis & Steiger, 1993; Rogers & Kaiser, 1995) guided the redevelopment of this unit.

Invitational Education as defined by Purkey and Novak (1992) is based on four key components which provide a general framework for thinking and acting on what is believed to be worthwhile in schools.

- Respect. People are able, valuable and responsible and should be treated accordingly.
- Trust. Education is a co-operative collaborative activity where process is as important as product.
- Optimism. People possess untapped potential in all areas of worthwhile human behavior.
- Intentionality. Human potential is best realized by creating and maintaining places, policies, processes and programs designed to invite development and by people who are intentionally inviting with themselves and others personally and professionally.

These approaches have been described as inclusive (Dickman, 1993), and have much in common with the concepts of Connected Teaching. Connected teaching encourages all students to engage in the process of thinking about and discovering concepts together with the lecturer, and this requires that students and teachers trust and respect each other and their approaches. Alternate methods of solution are encouraged and diversity of approach is welcomed in discussions. Truth or knowledge is constructed through consensus and mutual respect, not through conflict. Connected teachers trust their students thinking and encourage them to expand

upon it. Connected teaching also requires that the teacher connects the concepts with the real world and with students background and experiences.

Invitational theory focuses on five areas, known as the five "Ps". In the context of this course, policies, processes and people were important. Each of these are described below.

POLICIES

The Electrical Engineering 105 course consisted of mass lectures for two hours each week, small group tutorials for one hour per week, and small group laboratory sessions for two hours every week. The lecturer taught the mass lectures each week, and coordinated the tutorial and laboratory sessions. The lectures were all prepared using Power Point, and made available on-line for students to refer to after lectures. A unique feature of the 1999 course was the use of WebCT software to facilitate on-line sharing of problem solutions and discussions. The class was divided into six tutorial groups. Each group had a different set of problems for assignment 1. After the group had solved the problems, the lecturer checked the solutions, and these were the posted to the WebCT bulletin board. Then each group commented on another group's solution, so that for every assignment, the group had to work on problems in two different ways: One to solve and one to comment. Comments were also posted to the bulletin board. This process rotated throughout the semester so each group commented on a different groups solution each time.

Assessment of the course did not conform to the traditional structure of a mid-semester test worth 20% and a two-hour final exam worth 80%. (See Table 1 below.) By breaking the assessment into many components of different formats, a much wider range of skills and knowledge was assessed. Previous research has suggested (Foxman, Ruddock, & McCallum, 1990; Murphy, 1993; Parker & Tims (Goodell), 1995; Volkoff & Hocevar, 1995) that the format of an assessment task can advantage certain groups of students over others. By varying the format, all groups (males and females, groups from different cultural backgrounds etc.) are catered for.

Students were also permitted to negotiate alternative assessments if they had difficulty (for any reason) in completing the assigned work on time. The lecturer kept detailed records on a spreadsheet, so that any student who had not handed in an assignment could be personally

contacted and asked why the assignment was missing. Students were given the opportunity to redeem their grade by completing a different assignment to the original one. The substitute assignment had more problems than the original so that other students would have no grounds to complain that some were treated better than themselves who worked hard to meet the deadline for the submission date.

Table 1
Assessment Structure for Electrical Engineering 105

Assessment Format	Marks
Assignments (5 total)	20 Marks
Mid-semester test Part I open book 1 hour duration	10 Marks
Mid-semester test Part II closed book 1 hour duration	10 Marks
Laboratory test including experimental work	10 Marks
Laboratory pre-lab work, participation and post-lab work	5 Marks
Short laboratory formal report	5 Marks
Final examination open book 2 hours duration	40 Marks
Total	**100 Marks**

PROCESSES

The processes by which the policies were implemented played a huge part in the success of this initiative. Through these processes, trust, respect, optimism and intentionality were all developed. Each of these area is discussed below.

Intentionality and connecting with students

In the first lecture, the unit outline (syllabus) was given to the students. In that unit outline was an invitation to communicate with lecturer through e-mail to tell him a little about themselves and their educational background. (As part of the university's commitment to creating an electronic campus, all first-year students were given an email account at the beginning of semester). Below is the text of that invitation.

> *Please send an e-mail and briefly comment on your background such as previous physics courses, computer background, calculus, etc. Tell me also what you hope to learn and achieve from this unit. This is very important and such information is needed to better plan*

the unit throughout the semester. It will be kept confidential at all times. Please include your full name and student number as your e-mail account does not have your full name.

This invitation fulfilled the dual role of inviting students to participate and providing background information for the lecturer to assist him to in getting to know the students on a more personal level, an important part of connected teaching.

Intentionality was also facilitated through the group solutions and on-line discussions of assignment problems. Students were very pleased to receive the assignment problem solutions, but in order to gain the most benefit from this, they had to participate in producing their group's solutions and comments. The students felt no threat in participating in the discussions as the response was from the whole group, not an individual.

Respect

The lecturer was particularly careful to present an "approachable" as opposed to an "aloof" image to the students in the first few weeks. In response to feedback from the 1997 group of students that it was intimidating for first-year students to hear the professional qualifications of the lecturer and his/her experiences in general, the lecturer introduced himself only by name, not detailing his qualifications and experience until much later in the semester when the students knew him a little better.

He also demonstrated his respect for them by being very well prepared for the lectures, and producing high-quality materials in the form of Power Point lectures with many real-life examples and clear diagrams, and a very detailed laboratory manual. The contexts for problems, discussions and real-world applications focused on areas such as medical applications of electro-magnetic fields (magnetic resonance imaging) and the development of renewable energy sources, topics which are relevant to all students. By making every effort to be inclusive, all students, including the non-traditional students, developed respect for him. This is in contrast to traditional physics problems which are set in contexts that concentrate on war, heavy machinery or other areas which appeal mainly to young males; or in many cases have no context at all, instead referring to "frictionless bodies" moving about in space (Rennie & Parker, 1993a; Rennie & Parker, 1993b).

Trust

An important part of developing trust was the lecturer getting to know as many students as possible by name. He made a concerted effort to learn student names as soon as possible, and students were amazed at how many names he knew, especially given the large size of the group (over 200 students). This process was greatly facilitated through the email communication he invited students to participate in at the beginning of the semester. He also attempted to involve students in large lectures by breaking them up into small groups for discussions during the lecture. This is also advocated by Nair and Majetich (1995) when teaching large science or engineering classes as a way to teach inclusively and overcome gender barriers. This contrasts sharply with the traditional impersonal lecture style often encountered in large first-year classes, particularly in engineering and science.

Students also developed trust in the lecturer through the feedback he gave on the assignment questions and comments posted to the web site. All solutions were checked before being posted, so students knew they could trust the web site for correctness.

Another aspect of the trust the lecturer developed was his availability out of class, and his prompt response to email messages sent by the students. Students felt comfortable approaching him for help, and he often saw students out of office hours. They could email him questions at any time and know that they would get a quick response.

STUDENT REACTIONS AND EVALUATIONS

The large number of e-mail messages received by the lecturer in both 1998 and 1999 were a clear indication that good communication was indeed established. The topics of the e-mail messages covered a large range, including students' plans for the future, their high-school background, difficulties they were experiencing with the course content or speed of delivery, transition issues, and what students expected to gain from the unit. Some students also offered to help the lecturer in various ways, and many thanked him for his dedication. The process was very time consuming for the lecturer, but he felt that deriving greatly increased satisfaction with his teaching, and the considerable positive feedback from his students was worth the time invested.

Invitational Teaching Survey

Methods and Data Sources

In 1999, a modified version of the Invitational Teaching Survey (ITS) was administered at the end of semester. Students were asked to respond on a five point Likert scale about the frequency of listed behaviors. The responses were 1 - Almost Never, 2 - Seldom, 3 - Sometimes, 4 - Often, and 5 - Very Often. A copy of this instrument can be found in Appendix 1, and the average scores obtained on each item are listed in Appendix 2.

Principal components rotated varimax factor analysis was carried out on the data. Alpha reliabilities were calculated for each of the four factors identified by the factor analysis.

Two open ended questions were also asked in this survey: "What problems have you encountered in making the transition to University studies," and "What else could the lecturer have done to enhance your first semester experience at the School of Electrical and Computer Engineering?" Responses were summarized and categorized.

Results

The factor analysis identified four factors. These were named Teaching Methods, Invites Participation, Respects Students, and Connects with Students. Factor items and loadings are listed in Appendix 3. Mean scores on each factor and the reliability of each factor is listed below in Table 2

Table 2

Invitational Teaching Survey Factor Means and Reliabilities

Factor	Mean score	Number of Items	Number of Cases	Reliability (Alpha)
Teaching Methods	3.8	8	87	.76
Invites Participation	3.8	6	85	.70
Respects Students	4.3	6	88	.68
Connects with Students	2.9	3	89	.60

The first open-ended asked students "What problems have you encountered in making the transition to University studies?" A majority of responses concerned students' perceived lack of study skills and time management skills, the much greater workload and the vastly different teaching style as compared to high-school. Below are a fairly representative selection of comments students wrote.

- Having less time to do a whole lot more work. Uni. finishes way later than school and have other activities. However Vassilios understood this and didn't make unfair demands in terms of work.
- Meeting deadlines has been a problem but also having to learn in such big groups is a bigger problem. Knowledge assumed has been a bit of a problem at times.
- The increased workload incorporated with the new concept that you are now solely responsible for your education/learning rather than teachers chasing you up for due assessments.
- The lecturers don't complain if you don't do your homework, so there is less incentive to do it. Lots harder.
- For electrical engineering in particular, problems I encountered were purely due to lack of my knowledge on physics. I have done physics in high school only for one year (~ 16 years ago) and in my native language. Despite this, because of the way the course was conducted, I was able to learn a lot. Maybe I could not keep up with the rest of the class, because I had to start from basics, but the references to basics (e.g. vectors) helped.
- Culture shock, lack of proper background in calculus. Dr. Vassilios and I sat down and went through my personal problems. By the end of the conversation I felt more confident in success.

The second open-ended question asked students "What else could the lecturer have done to enhance your first semester experience at the School of Electrical and Computer Engineering?" The responses to this were extremely positive response: nearly every student wrote that the lecturer had done all that he could to assist them. This was a vastly different situation to the responses given in 1997 when the course was run for the first time. In that round of evaluation,

students were quite critical of the course and the lecturer, which is what prompted him to find different ways of conducting the course.

CONCLUSIONS AND IMPLICATIONS

The approaches of Connected Teaching and Invitational Teaching were combined by this lecturer to create an inclusive and inviting learning environment. The use of WebCT software and electronic lectures enhanced both approaches by making the content more accessible, promoting cooperative learning, and facilitating communication between student and lecturer. As competition between universities intensifies through the availability of on-line courses, the approaches described in this paper, if adopted, will enhance personal connections between students and lecturers which will help students' make the transition from high school to university and ultimately enhance first-year retention rates.

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School of Electrical and Computer Engineering

Invitational Teaching Survey 1999

In the Electrical Engineering 105 unit, in 1st semester 1999, the teaching approach used was based on the qualities of invitational education (Purkey, 1978). We are interested in your views about the implementation of this model and how it affected your learning and transition to University studies. The survey responses are anonymous. However, the results will provide feedback to the lecturer and be used to demonstrate the effectiveness or otherwise of this model of teaching in the University setting.

Part A:

Please answer the following questions by circling the appropriate response based on your experience with the lecturer you had in the Electrical Engineering 105 unit in 1st semester 1999, namely Dr. Vassilios G. Agelidis.

		Almost Never	Seldom	Sometimes	Very Often	Often
1	Invites students to communicate regularly.	1	2	3	4	5
2	Shows a lack of respect for students.	1	2	3	4	5
3	Makes a special effort to learn students' names.	1	2	3	4	5
4	Demonstrates a lack of enthusiasm about the course.	1	2	3	4	5
5	Shares out-of-class experiences.	1	2	3	4	5
6	Relates course content to the "real world".	1	2	3	4	5
7	Uses a variety of methods to help students learn.	1	2	3	4	5
8	Has difficulty in facilitating class discussion.	1	2	3	4	5
9	Involves students in decision-making processes.	1	2	3	4	5
10	Demonstrates an up-to-date knowledge of course content.	1	2	3	4	5
11	Is never available to talk to students out-of-class.	1	2	3	4	5
12	Treats students as though they are irresponsible.	1	2	3	4	5
13	Is unfriendly towards students.	1	2	3	4	5
14	Provides an overview of each lesson.	1	2	3	4	5
15	Shows sensitivity to the needs of students.	1	2	3	4	5
16	Works to develop students' self-confidence.	1	2	3	4	5
17	Takes time to talk with students about their out-of-class activities.	1	2	3	4	5
18	Pauses for several seconds after asking a question.	1	2	3	4	5
19	Incorporates student suggestions.	1	2	3	4	5
20	Asks questions to stimulate thinking.	1	2	3	4	5
21	Is unwilling to help students having special problems.	1	2	3	4	5
22	Expects high academic performance from students.	1	2	3	4	5
23	Is unwilling to admit a mistake or lack of knowledge on a subject.	1	2	3	4	5
24	Presents a smooth transition from one topic to another.	1	2	3	4	5

Part B:

What problems have you encountered in making the transition to University studies?

What else could the lecturer have done to enhance your first semester experience at the School of Electrical and Computer Engineering?

Thank you for completing this form.

Dr. Joanne E. Goodell, Research Director, OSI Discovery, Miami University, Oxford, Ohio, USA.
Dr. Vassilios G. Agelidis, Senior Lecturer, School of Electrical and Computer Engineering.

Monday, 31 May 1999

Appendix 2

Mean Scores on Individual Items of Invitational Teaching Survey

Question number	Question	Mean score
1	Invites students to communicate regularly.	4.0
R 2	Shows a lack of respect for students.	4.7
3	Makes a special effort to learn students' names.	3.8
R 4	Demonstrates a lack of enthusiasm about the course.	4.2
5	Shares out-of-class experiences.	3.4
6	Relates course content to the "real world".	3.1
7	Uses a variety of methods to help students learn.	3.2
R 8	Has difficulty in facilitating class discussion.	3.9
9	Involves students in decision-making processes.	3.4
10	Demonstrates an up-to-date knowledge of course content.	3.9
R 11	Is never available to talk to students out-of-class.	4.3
R 12	Treats students as though they are irresponsible.	4.6
R 13	Is unfriendly towards students.	4.7
14	Provides an overview of each lesson.	4.0
15	Shows sensitivity to the needs of students.	3.8
16	Works to develop students' self-confidence.	3.5
17	Takes time to talk with students about their out-of-class activities.	2.4
18	Pauses for several seconds after asking a question.	3.9
19	Incorporates student suggestions.	3.6
20	Asks questions to stimulate thinking.	4.0
R 21	Is unwilling to help students having special problems.	4.5
22	Expects high academic performance from students.	3.4
R 23	Is unwilling to admit a mistake or lack of knowledge on a subject.	4.4
24	Presents a smooth transition from one topic to another.	3.8

n = 90

NB: Items marked "R" were reverse scored.

Appendix 3

Table 3

Factor loadings for Invitational Teaching Survey

Factor 1	*Teaching Methods*	*Loading*
7	Uses a variety of methods to help students learn.	.37
R 8	Has difficulty in facilitating class discussion.	.53
14	Provides an overview of each lesson.	.65
15	Shows sensitivity to the needs of students.	.81
16	Works to develop students' self-confidence.	.62
18	Pauses for several seconds after asking a question.	.41
20	Asks questions to stimulate thinking.	.44
24	Presents a smooth transition from one topic to another.	.64
Factor 2	*Invites Participation*	
1	Invites students to communicate regularly.	.65
3	Makes a special effort to learn students' names.	.68
R 4	Demonstrates a lack of enthusiasm about the course.	.39
9	Involves students in decision-making processes.	.51
10	Demonstrates an up-to-date knowledge of course content.	.60
22	Expects high academic performance from students.	.56
Factor 3	*Respects Students*	
R 2	Shows a lack of respect for students.	.63
R 11	Is never available to talk to students out-of-class.	.49
R 12	Treats students as though they are irresponsible.	.52
19	Incorporates student suggestions.	.37
R 21	Is unwilling to help students having special problems.	.67
R 23	Is unwilling to admit a mistake or lack of knowledge on a subject.	.65
Factor 4	*Connects with Students*	
5	Shares out-of-class experiences.	.61
6	Relates course content to the "real world".	.75
17	Takes time to talk with students about their out-of-class activities.	.72

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	E-Mail Address: j.goodell@csuohio.edu Date: 9-8-2000

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